FEDERAL R&D EXPENDITURES AND THE GEOGRAPHIC DISTRIBUTION OF R&D ACTIVITY

by

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Working Paper

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I. Introduction

In recent years the proposition has been advanced and generally accepted that the unequal distribution of federal R&D funds among regions has increased the geographic concentration of R&D activity and, as a result, increased regional disparities in economic development and the quality and availability of higher education. A more equal distribution of funds has been advocated in order to reduce the resulting disparities among regions.[1] In this sense the existing geographic distribution of federal R&D has been considered inequitable.

The definition of this problem has evolved since 1963 when it was first identified in hearings before the House Subcommittee on Science, Research, and Development. The concept of the equitable distribution of federal R&D funds and the evolution of congressional and presidental concern with the issues involved are discussed in a previous report by the senior author [1].

These conclusions about the effect of federal R&D funds on regions involve a number of assumptions that may or may not be applicable. R&D activity and, in turn, economic activity and higher education in any given region are presumed to be strongly responsive to the federal R&D funds allocated in that region. Also the regional

[1] This argument is followed in individual testimony before Congress, for example, in [16], pp. 71-73, and [14], p. 554. See also the findings of the Daddario Subcommittee in [13], pp. 48-52.

distribution of federal R&D funds is assumed to have become more concentrated and thus to have resulted in a more unequal regional distribution of R&D activity.

Our main purpose in this paper is to offer some evidence about the extent of changes that have taken place in the geographic concentration of R&D activity and federal R&D funds. The relationship and responsiveness of regional economic development and higher education to changes in federal R&D funds has been discussed in [1]. First, we describe the data and methodology used to indicate the extent of geographic concentration; then, we examine the extent to which changes in concentration have occurred in recent years.

II. Data and Methodology

Our analysis requires data that would indicate for a number of years the regional distributions of R&D performance and R&D expenditures involving federal funds. Only approximate measures of these distributions can be used. Regional data are available for 50 states plus the District of Columbia for the period 1961-1966.

The most frequently used measures of R&D performance are R&D expenditures and R&D employment. Data on industrial R&D expenditures for 1962-1964 are available for most, but not all, states [7]; however, they are not available for total R&D expenditures. Data on the distribution of scientists by states are available for the even years 1960-1966 [6, 11]. These data are used in our analysis, as a measure of R&D performance for the years 1962, 1964, and 1966. An obvious shortcoming

of this approach involves the exclusion of engineers and other technical personnel, particularly in view of their importance in development.

Federal R&D obligations are used as a measure of the regional distribution of expenditures of federal R&D funds. These data are available by states for fiscal years 1961-1965 [9, 10]. However, the actual expenditure of R&D funds may not be limited to the year or the region in which the obligations are incurred. In the case of the time period involved, there is some evidence that the timing of expenditures is more likely to coincide with the timing of R&D obligations than procurement obligations [2]. The geographic distribution of R&D obligations does not reflect the influence of subcontracting and intrafirm transfers of R&D funds. The subcontract data that are available for 1963 and 1965 appear to indicate that the subcontracting process tends to lessen the concentration of federal R&D funds [9, pp. 34-37 and 13, pp. 17-19].

Federal R&D obligations data for the years 1961, 1963, and 1965 are used in our analysis. However, geographic data on federal R&D obligations for both extramural and intramural performers are only available for the years after 1962. The 1961 data for states include only extramural R&D obligations. The state distribution of R&D funds obligated to intramural performers has shown greater stability than the distributions of other performers, and, in general, the relative positions of individual states have remained unchanged since 1963 [9, p. 14]. Therefore, we have assumed that the distribution

of intramural R&D obligations did not change during 1961-1963 in order to obtain comparable data for 1961. The total intramural obligations in 1961 are allocated among states according to their shares of intramural funds in 1963.

The Gini coefficient will be used to determine the extent of concentration or unequality in the regional distributions of scientists and federal R&D funds in any given year.[2] The coefficient represents a measure of the relative inequality of a distribution that is shown by the area between the Lorenz curve of that distribution and the line of equality. Its value is equal to the ratio of this area to the total area under the line of equality and can vary between zero, indicating absolute equality, and one, indicating absolute inequality.

III. Some Shades of Regional Inequality

Gini coefficients describing the extent of inequality in the distribution of scientists among states for 1962, 1964, and 1966 are shown in Table 1, along with Gini coefficients for other distributions. The coefficients for the distribution of scientists have a value of .55 for each year; this suggests not only a fairly high degree of inequality in the distribution of scientists among regions, but the absence of any changes in the relative inequality of the distribution during 1962-1966.

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[2] A number of measures of the inequality of a distribution are available in addition to the Gini coefficient. The Gini coefficient and alternative methods are discussed, for example, in [3], pp. 243-244, [4], pp. 160-167, and [5]. The mechanics of computing the value of the Gini coefficient are discussed in [5], pp. 162-163.

This measure of R&D performance is somewhat narrow, however, because it does not include other sources of scientific manpower. Data on the state distribution of scientists and engineers in 1960 are available [12, p. 194], and these data can yield at least an indication of the relative inequality of a distribution with additional types of scientific manpower. A more unequal distribution might be expected both because engineers, unlike scientists, are much more likely to be engaged in development than basic and applied research [1, p. 192] and because development tends to be more concentrated than applied and basic research. In this sense, the number of scientists is likely to be a better measure of research than of development. In fact, the state distribution of scientists and engineers in 1960 has a Gini coefficient of 0.595 indicating perhaps a somewhat greater inequality than for the distribution of scientists. The surprising thing is that this difference is so small.

We have also used the Gini coefficient as a measure of the inequality of the state distribution of federal R&D funds relative to the distribution of scientists. The distribution of federal R&D funds in fiscal year 1961, 1963, and 1965 is compared to the corresponding 1962, 1964, and 1966 distribution of scientists. In this case, a positive-or negative-valued Gini coefficient indicates that the federal R&D funds are, respectively, less or more equally distributed among states than scientists. The coefficients are equal to 0.462, 0.449, and 0.465, respectively, for FY 1961/1962, FY 1963/1964, and FY 1965/1966. These values indicate that federal R&D funds are more

TABLE 1

GINI COEFFICIENTS

Distribution of Scientists among States	
1962	0.552
1964	0.555
1966	0.551
Distribution of Scientists and Engineers among States	
1960	0.595

State Distribution of Federal R&D Funds Relative to the State Distribution of:		
	Total Scientists	R&D Scientists
FY 1961/1962	0.462	0.431
FY 1963/1964	0.449	0.415
FY 1965/1966	0.465	---

highly concentrated than scientists and that the extent of inequality between the two distributions has remained constant during this time. In light of the stability of the Gini coefficients for the state distribution of scientists in 1962-1966, these results further suggest a fairly stable concentration of federal R&D funds among states.

The distributions of scientists used above include all scientists whether or not they are engaged in R&D. Data on the state distribution of scientists primarily engaged in R&D are available for 1962 and 1964 [6]. A comparison of the state distributions of federal R&D funds and R&D scientists yields Gini coefficients of 0.431 and 0.415 for the two periods. This substitution of R&D scientists appears to result in a slightly lesser inequality between the two distributions, but does not affect the stability of the coefficients in the two periods.

In conclusion, our findings do not support the contention that the distributions of federal R&D funds and R&D performance are becoming less equal. Rather the available data suggest considerable stability exists in the degree of inequality involved in the distributions.

REFERENCES

[1] Brazzel, John M. Regional Equity and the Geographic Distribution of Federal R&D Funds. Working Paper, Research Center, School of Business and Public Administration, University of Missouri, September, 1967.

[2] Greenberg, Edward. "Employment Impacts of Defense Expenditures and Obligations," Review of Economics and Statistics, Vol. XLIX (May, 1967), pp. 186-197.

[3] Horowitz, Ira. "The Regional Distribution of Schentific Talent," Southern Economic Journal, Vol. XXXI (Jan., 1965), pp. 238-250.

[4] Mendershausen, Horst. Changes in Income Distribution During the Great Depression. New York: National Bureau of Economic Research, 1946.

[5] Prais, S.J. "The Statistical Conditions for a Change in Business Concentration," Review of Economics and Statistics, Vol. XXXIX (August, 1958), pp. 268-272.

[6] National Science Foundation. American Science Manpower: A Report of the National Register of Scientific and Technical Personnel. Washington: U.S. Government Printing Office, 1962 and 1964 editions.

[7] _____. Basic Research, Applied Research, and Development in Industry. Washington: U.S. Government Printing Office, 1962, 1963, and 1964 editions.

[8] _____. Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1965, 1966, and 1967. Vol. XV, Washington: U.S. Government Printing Office, 1966.

[9] _____. Geographic Distribution of Federal Funds for Research and Development Fiscal Year 1965. Washington: U.S. Government Printing Office, 1967.

[10] _____. Obligations for Research and Development, and R&D Plant, by Geographic Divisions and States, by Selected Federal Agencies, Fiscal Years 1961-1964. Report to the Subcommittee on Science, Research, and Development, U.S. House of Representatives. Washington: U.S. Government Printing Office, 1964.

[11] _____. "Salaries and Selected Characteristics of U.S. Scientists, 1966," Reviews of Data on Science Resources, No. 11 (December, 1966).

[12] U.S. House of Representatives, Select Committee on Government Research. Statistical Review of Research and Development. Study IX. 88th Cong., 2nd Sess., 1964.

[13] _____. Subcommittee on Science, Research, and Development. Geographic Distribution of Federal Research and Development Funds. 88th Cong., 2nd Sess., February 25, 1965.

[14] _____. Hearings on Government and Science: Distribution of Federal Research Funds and Indirect Costs Re Federal Grants. 88th Cong., 2nd Sess., 1964.

[15] U.S. Senate, Subcommittee on Government Research. Hearings on the Equitable Distribution of R&D Funds by Government Agencies. 89th Cong., 2nd Sess., 1967.

[16] _____. Subcommittee on Employment and Manpower. Hearings on the Impact of Federal Research and Development Policies on Scientific and Technical Manpower. 89th Cong., 1st Sess., 1965.

[17] Weidenbaum, Murray L. Federal Financing of Research and Development and the Regional Distribution of Income. Department of Economics, Washington University, Working Paper 6526, January 1966.

[18] _____. "Shifting the Composition of Government Spending: Implications for the Regional Distribution of Income," Papers, Regional Science Association, Vol. XVII (1966), pp. 163-178.